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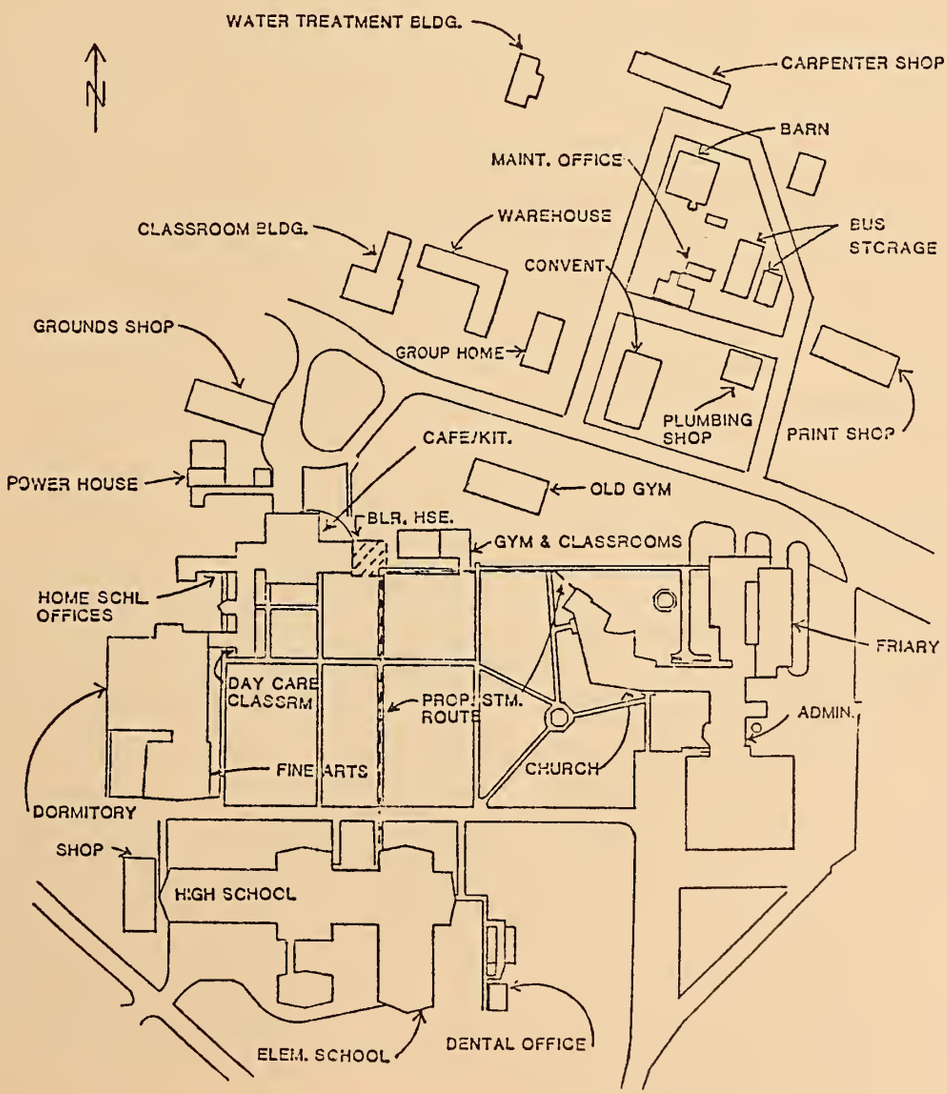
WOOD WASTE REPLACES ELECTRICITY, OIL, PROPANE

Energy Bills Cut $100,000 at Mission School

The prospect of free fuel is rarely a consideration when it comes time to replace outdated heating and cooling equipment. At the St. Labre Indian Mission School in Ashland, however, administrators looking for ways to save energy saw an opportunity to acquire a long-term supply of free sawmill waste for fuel. They realized that they could kill two birds with one stone if they were to install wood-fired boilers to meet most of their energy needs, and at the same time purchase and reopen a nearby sawmill that could provide the wood waste. This action would also help relieve chronic unemployment on the Northern Cheyenne Indian Reservation.

The St. Labre School is operated by the Franciscan Capuchin order of the Catholic Church, which is concerned with education and employment in the Northern Cheyenne community. Approximately 400 Northern Cheyenne and Crow Indian students attend the school in grades kindergarten through high school. The operation also includes St. Labre Homes, which is affiliated with the Boys Town home for children. Approximately 300 people are employed at the school and mission complex as teachers, maintenance workers, or as part of the school's direct-mail, fund raising operation. Brother Paul Courchaine is the manager of the school and mission.

Brother Paul said that when he arrived at the school, it was clear that changes were needed. Some of the buildings in the rambling, 5-acre complex were run down, roofs were leaking, and energy bills were high and getting higher. Space heating, cooking, and water heating were →



Layout of St. Labre Indian Mission School, Ashland Montana

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accomplished with an array of outdated equipment. Some of this equipment used fuel oil, some used propane, and some operated with electricity.

Brother Paul had learned ways to save energy at another Capuchin school that he headed in Wisconsin, and he began thinking about what could be done to reduce the school's high energy bills. Records show that fuel oil bills averaged about $3,000 per month in the winter of 1987-1988, the last winter that fuel oil was used at the school. Propane costs from October 1987 through April 1988 averaged about $1,000 per month.

Although oil and propane costs were substantial, the stiffest bills were for electricity, which sometimes costs more than $12,000 per month in the winter, and averaged about $6,000 per month in the summer. Monthly electric bills averaged $9,000 in 1987, the last year before the new equipment was installed. Most electrical use in the winter was for space heating; in the summer it was for water heating and air conditioning.

At the school he managed in Wisconsin, Brother Paul had hired the engineering firm of R.J. Miller Associates from Milwaukee to analyze energy use, and he decided to hire the firm again. Representatives of R.J. Miller performed an energy audit of St. Labre and determined the potential for big improvements. Brother Paul said that while various possibilities were being considered for cutting energy use at the school, one idea kept coming up: "It's too bad the mill is not operating."

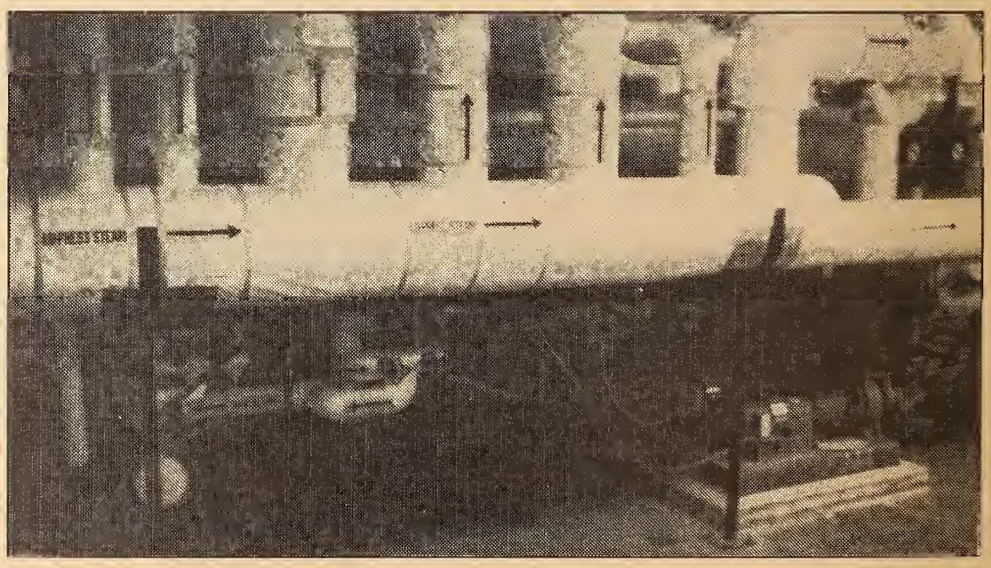
The mill in question was a sawmill that had a long history of opening and operating for awhile and then shutting down again. This mill is only about 500 yards from the school, and Brother Paul reasoned that if the Church could purchase the mill, it could be operated to provide employment and free fuel for a wood-fired heating and cooling plant at the school. Estimates showed that upwards of 180 steady jobs could be provided.

Opening the mill and remodeling the school with wood-fired boilers was a good idea, but it required a lot of money. Records show that the final cost of the work was $1,640,000. Brother Paul said, "We scrounged everywhere to get money."

The project was partly financed with $189,000 provided by the Montana Department of Natural Resources and Conservation (DNRC). The DNRC funds came from the Institutional Conservation Program, which channels U.S. Department of Energy money into energy-saving projects at schools and hospitals.

When adequate funding was assured, contracts were let and work began in the spring of 1988. The heart of the project was the installation of two 350 horsepower Kewaunee boilers that furnish steam to operate the heating and cooling equipment. The boilers were purchased, slightly used, from Minnesota, and installed in a new centralized heating/cooling plant that was built for them. The steam-operated cooling equipment includes two absorption chillers to provide cold water for air conditioning. The new equipment is expected to save $104,000 a year in energy costs, calculated at 1988 prices.

The location of the heating plant was chosen to minimize pipe runs to the buildings that were to be heated and cooled, while allowing easy access for trucks delivering wood-waste fuel from the sawmill. Pipelines lead from the boilers →



A steam-to-water heat exchanger in the new wood-fired system replaced the propane hot water heaters.

and chillers to various buildings on the campus. The pipes carry steam for heating and chilled water for cooling and also function as return lines for condensate and water. Buildings served include the gymnasium, cafeteria/laundry/home economics building, fine arts/ dormitory building, classrooms, dormitories, staff residences, the elementary/ high school building, school shop building, administrative offices, museum, and church. The total floorspace served by the new equipment is 160,000 square feet, or about 3¾ acres.

Buildings that are not presently served by the steam and chilled water pipes continue to be heated and cooled with electricity. However, steam lines installed in the elementary school and high school were oversized and provided with fittings that allow them to be extended to ➞

Institutional Conservation Program

The Institutional Conservation Program (ICP) is a federal program that provides 50 percent matching funds for energy conservation measures in schools and hospitals built before 1977. Funded by the U.S Department of Energy (DOE), ICP is administered in Montana by the Department of Natural Resources and Conservation. Since 1978, more than 160 Montana institutions have been awarded over $6.6 million in ICP grants for the installation of energy saving improvements.

ICP offers grants for the preparation of technical reports and the installation of energy conservation improvements recommended in the reports. The reports include a detailed engineering analysis of a building's thermal performance and architectural design. The reports specifically identify the energy saving modifications that are most cost effective for a structure.

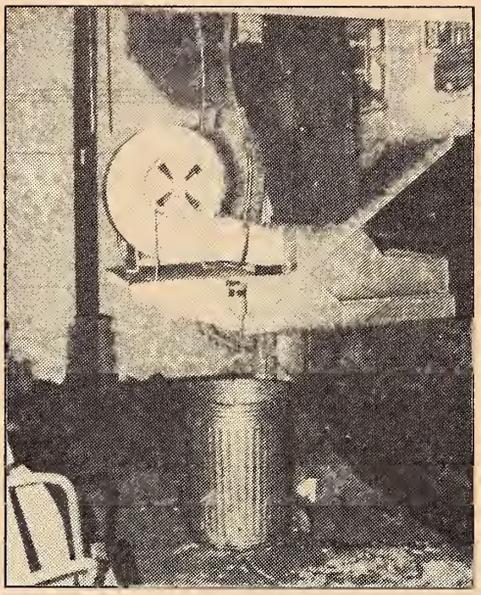
Energy-saving modifications that have a 2- to-10 year simple payback are eligible for grant funding. The applicant can request funding for any of the conservation measures identified in the report. Funding is awarded on a competitive basis. Each energy saving measure in an application is ranked based on the simple payback, conversion to renewable, cogeneration, or coal fuel source, type and quantity of fuel saved, and quality of the technical report. Program funding levels vary from year to year depending on the annual allocation from DOE and from the amount of state funds available that year. Grants are awarded and projects are initiated in the spring.

DNRC administers one ICP grant cycle each year. When an eligible institution receives funding to complete a technical report in one grant cycle, the technical report is completed after grants are awarded and is then submitted during the next grant cycle for review. An approved report may then be used to support an application for energy conservation project funding in the next year's grant cycle. As a result, **two years** occur between the initial application for report funding and the initiation of an energy conservation project.

To complete the technical report and apply for matching funds to implement suggested energy conservation modifications in a **single grant cycle**, eligible institutions often use their own funds, paying the full cost of the technical report. Institutions that are awarded grants for energy saving modifications can then apply the full technical report cost as part of their matching share of the project cost.

It should be noted that there's a chance an institution would not receive a grant for the energy conservation measures and then would have to bear the cost of the report.

For more information about ICP, including the funding amounts available and deadlines for grant applications, contact DNRC's Energy Division at 444-6697 and ask for the ICP manager.



Waste wood fuel is metered and blown into the firebox for mid-air combustion.

other nearby buildings in the future.

The wood-fired system started operation in September 1988, and remained on-line through the winter. Records show that electrical use during the winter of 1988-1989 was cut almost in half from the previous winter. Electrical costs for the period were cut from $19,520 to $11,795, despite a 16.3 percent increase in the price of electricity, and even though the weather was about 20 percent colder in 1988-1989. Also, two more buildings were added to the system, increasing the heating load by 6 percent.

Besides reducing the electric bill, the new boilers eliminated the use of fuel oil at St. Labre. From July 1987 to July 1988, fuel oil costs alone had amounted to $23,000.

Also, since the heating system came on-line in late 1988, propane use was reduced by about 20 percent, cutting the annual propane bill from $12,772 in fiscal year 1988 to $10,954 in fiscal year 1989. Propane use is expected to be reduced another 75 percent the following year, dropping the annual propane bill to $3,200. Under the present plan, the routine use of propane will be eliminated in 1990-1991, when all propane-fired water heaters and dryers are replaced. However, propane storage tanks and delivery lines will remain in place for backup use in the boilers.

Part of the reduced energy use has resulted from consolidating the heating facilities. For example, steam heat from the new plant replaced individual electric heaters in the gym, dormitories, fine arts building, and most other buildings in the complex. Other energy-using equipment that was eliminated includes the 118 horsepower oil-fired boiler that was used to heat the elementary school and high school, and two propane hot water heaters serving the cafeteria and laundry.

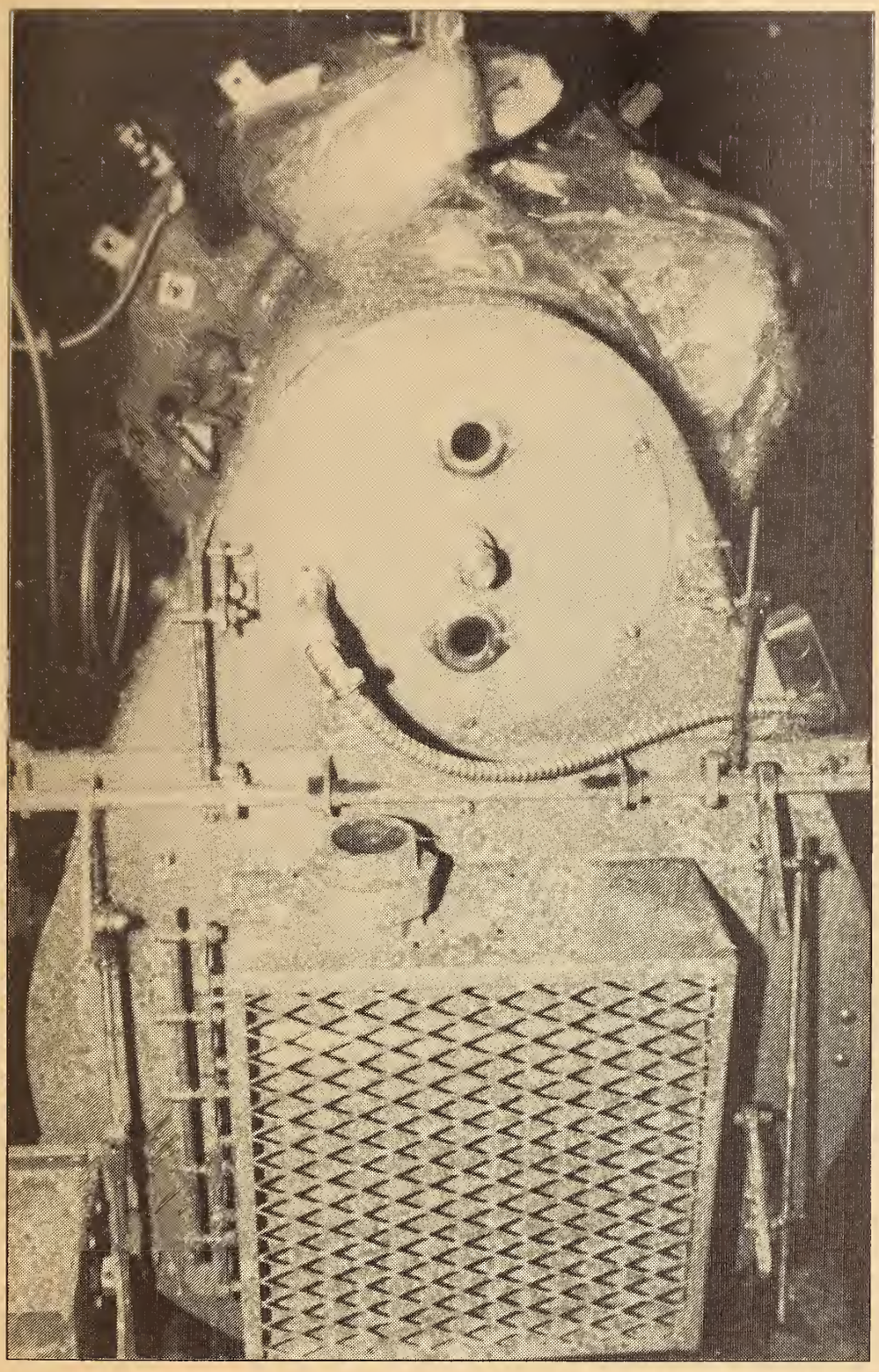
The new boilers have also led to improvements in the school's cooling system. In May 1989, the first absorption chiller went on-line to provide air conditioning for areas not previously cooled. The chiller also replaced four small rooftop air conditioners. Later in the summer of 1989, the second chiller went into operation to cool buildings not previously cooled, and to replace electric-powered cooling compressors that were previously used for cooling. The amount of energy needed to provide cooling with →

Automation Eases Handling of Wood Waste, Ashes

The handling of wood-waste fuel and ashes at the St. Labre site is efficient and routine. Fuel for the St. Labre boilers is mostly bark and sawdust, which is hauled from the mill on a live-bottom semi-trailer van. The "live bottom" is similar to a conveyor system, and it mechanically unloads the fuel into a concrete storage bunker under the boiler plant. This bunker was designed to hold enough fuel to charge the boilers for three days during severe weather conditions.

Augers controlled by the demand for steam move the fuel into the forced-air fuel injector, where it is blown into the firebox for mid-air combustion. Char and ash fall through a grate at the bottom of the firebox. An auger conveyor under the grate removes the ash to a container outside the building, and it is then hauled to a landfill on the mission grounds.

A multi-tube separator removes ash from the flue gases as they rise in the smokestack, and a conveyor deposits this ash with the bottom ash on its way to the waste container.



By riding on a rail between boilers, one propane burner can back up either boiler.

the chillers is about 80 percent less than required to cool the same floorspace with conventional compressors.

At present, the system has 100 percent boiler backup, because only one boiler is needed to provide all the heating and cooling on the campus. A backup propane burner is mounted on a rail so it can be moved readily to fire either boiler.

Brother Paul said the effect of the project on the operation of the school has been dramatic. "Before, I was worried about our high energy bills," he said. "Now we've got more steam than we know what to do with."

Quentin Sannes, manager of the Northern Cheyenne Pine Co. sawmill that furnishes the wood waste fuel, said the boiler at the school normally uses about 1 ton per hour of the bark and sawdust from the mill. The mill processes about 100,000 board feet of ponderosa pine lumber per day, Sannes said, providing jobs for 179 mill workers and numerous loggers. Northern Cheyenne Pine is committed to furnishing wood fuel to the school for 20 years. After 20 years, the fuel supply is unknown. "No telling what might happen in 20 years," Sannes said, adding that he thinks the mill will operate indefinitely and should be able to provide fuel long into the future.

The installation of new equipment at the mission school will continue for some time. Steam heat will be extended to areas currently heated with propane. Extension of heating and cooling to additional facilities will eventually require use of the second boiler during periods of high heat demand, but backup capacity will be sufficient to prevent any problems in case of emergency.

In summary, Brother Paul said, the decision to remodel the school certainly was the right one, and the benefits will grow over the years as the prices of conventional energy increase. ■

ICP—A Good Investment Option

In 1988, DNRC conducted a statistical analysis of the Institutional Conservation Program (ICP). The analysis extensively evaluated the energy-saving improvements installed in 24 gas-heated Montana schools between 1981 and 1985.

DNRC's analysis revealed that the schools had an average annual reduction in natural gas consumption of 28 percent. Further, the savings from reduced heating costs more than paid for the conservation measures that were installed. Findings showed that the selected conservation measures were typically cost-effective compared to other conventional investment opportunities. The statistics also confirmed that, in general, the technical reports prepared for ICP are good decision-making tools for both institutions and funding agencies.

As part of the analysis, DNRC calculated the expense of each conservation measure installed in the schools. The average cost of each modification was $36,700.

The simple payback for each modification ranged from 2 years to 10 years. Simple payback identifies the amount of time required for the savings generated by a conservation measure to equal the cost of implementing the measure. Simple payback is calculated by dividing the annual energy savings into the initial cost of the project.

DNRC also used the net present value approach to assess the value of each energy-saving project implemented in the 24 schools. The net present value approach compares the return received for installing a conservation measure to the return received for investing funds in an interest-bearing account. If a conservation measure has a positive net present value, the energy savings over the life of the measure are enough to repay the cost of the measure plus interest that would have been earned on that amount.

DNRC determined that, in most cases, the schools would earn more by investing in the energy-saving measures than by leaving the funds in the bank to earn interest. The average net present value of the modifications was $34,600 per school. This means the average school will earn $34,600 more through the useful life of the project by installing the energy-saving measures than would be earned by investing in conventional financial options during the same period. The combined net economic benefit to be realized by the 24 schools is $829,700.

DNRC's analysis of ICP, "Evaluation of Energy Conservation Measures in Montana Public Schools," was prepared by Mark Jackson in 1989. Copies are available upon request.

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